

# Robert E. Colgan

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## Education

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### Columbia University, New York, NY

Ph.D. in Computer Science

May 2022

- Thesis: "[Machine Learning for Gravitational-Wave Astronomy: Methods and Applications for High-Dimensional Laser Interferometry Data.](#)"

B.A. in Computer Science

May 2014

## Skills

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- Programming languages: proficient with Python, Java, MATLAB; familiar with C, C++.
- Libraries/tools/environments: PyTorch, NumPy/SciPy, scikit-learn, Matplotlib, Git, GitHub, Jupyter, Anaconda, AWS (EC2, Lambda), Slurm, OpenCV, PyCharm, Linux, Windows, Microsoft Office, LaTeX.

## Experience

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### Ph.D. research in applied machine learning with John Wright and Shree Nayar Sept. 2014–May 2022

- Spearheaded several research projects applying machine learning (ML) to high-dimensional, noisy data from the extremely sensitive and intricate Laser Interferometer Gravitational-Wave Observatory (LIGO) detectors.
  - Developed novel problem formulation for transient noise detection in LIGO auxiliary data channels.
  - Proposed, implemented, and co-authored [journal publication](#) on method that identifies noise events using features from 250,000+ time series with elastic net logistic regression, demonstrating for the first time how an efficient, interpretable ML method can accurately identify detector noise using all auxiliary data without observing the noise itself. Implemented project in Python with scikit-learn.
  - Conducted and [published](#) further work showing how sparse convolutional neural networks (CNNs) can reduce error rates by over 60% vs. logistic regression by learning features automatically from data and providing greater statistical capacity without sacrificing interpretability. Implemented with PyTorch.
  - [Demonstrated](#) the effectiveness and utility of these methods by applying them to a specific recurring type of transient noise in LIGO. Achieved classification accuracy of over 97% while independently corroborating results of previous manual investigations into the origins of this type of noise.
  - Wrote [Python module](#) to decompress custom LIGO binary format up to 200x faster than existing library.
- Collaborated in projects including object tracking in video with regression-based CNNs; robust sparse subspace clustering for motion segmentation of multiple moving objects; robust principal component analysis applied to air pollution exposure data; and robust parametric feature detection and face recognition.

### Computer science and mathematics tutor Sept. 2018–present

- Private tutor for various CS and math subjects including data structures and algorithms, artificial intelligence, Linux and C programming, introductory Python programming, and geometry.

### Teaching Assistant Sept. 2013–Dec. 2015; Jan. 2021–May 2021

Department of Computer Science, Columbia University, New York, NY

- Head TA (two semesters) and TA (one semester) for Computer Vision; head TA for Artificial Intelligence (one semester); TA for Introduction to Computer Science and Programming in Java (two semesters).

### Directed research with John Kender Sept. 2013–May 2014

- Developed methods in C++ for extracting thumbnails of frames from video without decompression as part of a collaborative project requiring fast indexing and matching of clips across a large database of videos.

### Fellow, AMALTHEA Research Experiences for Undergraduates (REU) Program May 2013–July 2013

Florida Institute of Technology, Melbourne, FL

- Researched and implemented dimensionality reduction algorithms in MATLAB for complex medical datasets.

### REU Intern and Research Assistant June 2012–May 2013

Lamont-Doherty Earth Observatory, Palisades, NY

- Developed methods for video analysis of hydrothermal vents by autonomous underwater vehicles in MATLAB.

## Awards and Fellowships

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Columbia University Department of Computer Science Service Award 2017

NSF Integrative Graduate Education and Research Traineeship: From Data to Solutions 2014–2016